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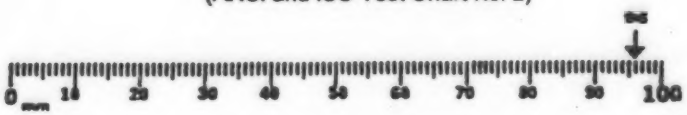


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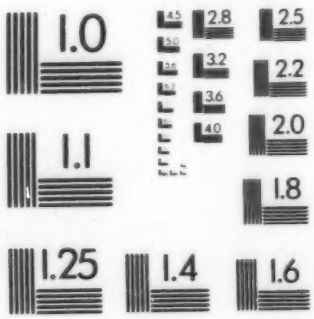


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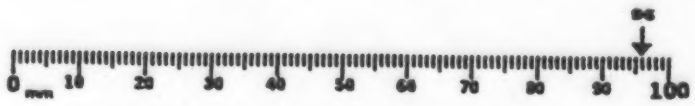


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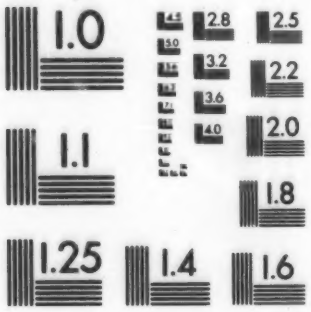


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# Overview of Commercial Fishing in Gilbert Bay, Labrador: Fish Harvesters Local Knowledge and Biological Observations

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March 2002

**Canadian Manuscript Report of Fisheries and Aquatic Sciences No. 2596**

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# Overview of Commercial Fishing in Gilbert Bay, Labrador; Fish Harvesters Local Knowledge and Biological Observations

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## ABSTRACT

Morris, C.J., J.M. Simms, and T.C. Anderson. 2002. Overview of commercial fishing in Gilbert Bay, Labrador; fish harvesters local knowledge and biological observations. Can. Manuscr. Rep. Fish. Aquat. Sci. 2596: vii + 34 p.

Gilbert Bay is located along the Labrador coast (52° 35'N 56° 00'W) near the communities of William's Harbour and Port Hope Simpson. It was designated as an Area of Interest (AOI) in the Marine Protected Areas (MPA) Program by DFO on October12, 2000, primarily because of the unique cod population in this bay. Fish harvesters were interviewed, fishing areas and cod spawning habitats were observed. Interviews followed a semi-structured format as outlined by Neis *et al.* (1996). Fish harvesters provided a wealth of information regarding commercial and non-commercial species. Scallop fishing is presently the primary commercial fishery in Gilbert Bay and fish harvesters indicate that this fishery should not be closed as part of a MPA. However, the majority of commercial fish harvesters indicated that Gilbert Bay cod should be given a level of protection from commercial fishing. Underwater video was useful in describing habitat, benthic species and the effects of scallop dredges. Information provided in this report could assist the development of future management plans.

## RÉSUMÉ

Morris, C.M., J.M. Simms, and T.C. Anderson. 2002. Overview of commercial fishing in Gilbert Bay, Labrador; fish harvesters local knowledge and biological observations. Can. Manuscr. Rep. Fish. Aquat. Sci. 2596 vii + 34 p.

La baie Gilbert se trouve sur la côte Sud du Labrador (52 ° 35'N – 56 ° 00'W), près des communautés de Williams Harbour et de Port Hope Simpson. Elle a été désignée le 12 octobre 2000 comme site d'intérêt dans le cadre du Programme des zones de protection marine (ZPM) par le ministère des Pêches et des Océans (MPO).; cette désignation était justifiée principalement par la présence dans la baie d'une population de morue tout à fait particulière. Nous avons interrogé des pêcheurs et observé les zones de pêche et les frayères de morue. Les entrevues suivaient le mode semi-structuré décrit par Neis *et al.* (1996). Les pêcheurs ont fourni une masse d'information concernant les espèces commerciales et non commerciales. À l'heure actuelle, la pêche du pétoncle est la principale pêche commerciale dans la baie, et les pêcheurs soulignent que cette pêche ne devrait pas fermer avec l'avènement de la ZPM. Par contre, la majorité des pêcheurs commerciaux se sont déclarés en faveur d'une protection de la morue de la baie Gilbert contre la pêche commerciale. La vidéo sous-marine a été précieuse pour décrire l'habitat, les espèces benthiques et les effets des dragues à pétoncles. L'information apportée par ce rapport pourrait être utile pour l'élaboration des plans futurs de gestion.

## INTRODUCTION

Gilbert Bay is located along the Labrador coast, 52° 35'N 56° 00'W (Fig.1). It meets several requirements of a Marine Protected Area (MPA), as outlined in the *National Framework for Establishing and Managing Marine Protected Areas* (DFO 1999) under the *Oceans Act*. The bay was initially identified as a potential MPA because of its resident Atlantic cod (*Gadus morhua*) population (Green and Wroblewski 2000; Morris 2000; Ruzzante *et al.*2000). In recent years, Atlantic cod in Gilbert Bay have experienced an increase in fishing pressure that may threaten the population. Consequently, communities adjacent to Gilbert Bay, namely Port Hope Simpson and Williams Harbour, proposed it as an Area of Interest (AOI) under the MPA Program in January 1999. The Department of Fisheries and Oceans (DFO) officially announced Gilbert Bay as an AOI, or potential MPA, on October 12, 2000.

Gilbert Bay contains a genetically distinguishable (Ruzzante *et al.* 2000; Beacham *et al.* 1999) resident population of Atlantic cod (Green and Wroblewski 2000; Morris 2000). Atlantic cod is found in continental shelf waters throughout the North Atlantic. Cod inhabiting the northwest Atlantic continental shelf are divided into stocks for management purposes. The northern cod stock consists of NAFO divisions 2J+3KL (Fig.1). Biological characteristics of the Gilbert Bay cod population, such as growth rate, and timing and location of spawning, differ from northern cod and other Atlantic cod populations (Morris 2000). Gilbert Bay cod represent the only known isolated population of Atlantic cod along the Labrador coast. The majority of inshore northern cod are found in several bays along the northeast coast of Newfoundland in winter (DFO 2001). Inshore cod are commonly called 'bay cod', whereas cod that spawn offshore, either migratory or non-migratory, are referred to as offshore cod in this report. The unique population of cod found in Gilbert Bay, hereinafter is referred to as Gilbert Bay cod or bay cod.

Historically, a single-family enterprise fished commercially in Gilbert Bay from the early 1970's until the fishery closed in 1992. In years immediately preceding the moratorium when the numbers of offshore fish were declining, fish harvesters from Williams Harbour and Port Hope Simpson increased their fishing efforts within the bay (Wroblewski 1998). Commercial fishing pressure may have reduced the natural level of abundance of Gilbert Bay cod before a fishing moratorium (1992-1998) on northern cod. Unlike offshore northern cod, the Gilbert Bay population appears to have increased during the fishing moratorium (Morris and Green [unpublished data]). When the commercial northern cod fishery re-opened in 1998, approximately 14 fishing boats were observed fishing cod in Gilbert Bay (George Rowe, Field Technician, P. O. Box 12, Port Hope Simpson, Labrador, AOK 4EO. Pers. Comm). In addition, commercial fishing in this area in 1998 targeted Gilbert Bay cod, whereas historically, effort included both these cod and migratory offshore cod. Increased fishing pressure on this small resident population is likely due to the absence of offshore fish on traditional fishing grounds. Since 1998, local people have expressed concern over the status of Gilbert Bay cod.

DFO restricted commercial and recreational Atlantic cod fishing from 70 percent of Gilbert Bay after 1998.

Presently, Atlantic cod and Iceland scallop (*Chlamys islandica*) are the most important commercial species fished in Gilbert Bay. Limited commercial and recreational Atlantic cod fishing has occurred in the outer part of Gilbert Bay since 1998 and a commercial scallop fishery has developed throughout the bay primarily since 1992. Aside from reported landings, there is little information that describes commercial fishing activities or the status of non-commercial species in Gilbert Bay. Interviewing resource users is a practical and relatively inexpensive method to review the status of various resources. For example, the wealth of information that fish harvesters possess pertaining to commercial and non-commercial species, if gathered in a systematic fashion, can contribute significantly to our understanding of local resources and fishing patterns (Neis *et al.* 1996).

Public participation and local community involvement has been widely recognized as an essential factor contributing to the success of MPAs (Kaza 1998; Rigney 1990; Fiske 1992; Wolfenden *et al.* 1994). In addition, the inclusion of both social and economic variables is recognized as an important consideration in the decision to establish MPAs (Sumaila 1998). Information obtained from commercial fish harvesters reflects social, economic, and resource status information. Their involvement early in the decision making process helps to ensure local support and that fish harvesters ultimately reap the expected benefits (Alder *et al.* 1994; Neis 1995).

This study combines information from several fish harvesters to describe commercial fishing activities and fishery resources in Gilbert Bay. It is based largely on observations by commercial fish harvesters, however, habitat descriptions are also included. Emphasis is placed on Atlantic cod and Iceland scallop since these are currently the most important commercial species in Gilbert Bay. Other species having potential commercial importance and the status of these various resources are also considered.

## METHODOLOGY

### INTERVIEWS

Interviews that gather resource information (particularly spatial aspects) require that the interviewer have a good understanding of the study area. For this project, the interviewer was familiar with the general area, local place names, commercial fishing locations, and general fishing activities, before conducting the interviews. This allowed interviews to progress quickly without detractions from the interview focus, which was to gather local knowledge from commercial fish harvesters regarding the marine resources in Gilbert Bay.

Commercial fish harvesters were interviewed in Port Hope Simpson and Williams Harbour from 24 July to 1 August, 2000. Interviews took place at a variety of locations including wharves, aboard fishing boats, and in the homes of fish harvesters. Written accounts of each interview were compiled to describe commercial fishing activities and noticeable trends observed by fish harvesters.

DFO conservation and protection officers helped to identify all commercial fish harvesters in Port Hope Simpson and Williams Harbour who fished in Gilbert Bay. Interviews were conducted with commercial fish harvesters that owned and operated a fishing boat, fished commercially for at least 15 years, and fished scallops within Gilbert Bay during the last decade. Several fish harvesters were involved in offshore fisheries and were unavailable for an interview. As a result, there were nine interviewees, representing approximately half of the fish harvesters from Williams Harbour and Port Hope Simpson meeting the interview criteria. Interviews were also conducted with three fish plant managers who have purchased Gilbert Bay cod in the past, and three local elders retired from the fishery. The majority of information included in this report was extracted from interviews with active commercial fish harvesters, because the sufficient sample size enabled cross-referencing to confirm individual accounts.

Information from a single interview was verified by at least two other interviewees (cross-referencing), before being included as part of the local ecological knowledge base. If information obtained from fish harvesters did not agree it was not considered a part of the local ecological knowledge. Interviews lasted between one and three hours. The interview considered the last decade, with the exception of three interviewees (retired fishers) who had not fished commercially during the past 10 years, and three interviews with fish plant managers who have not purchased Gilbert Bay cod since at least 1992.

Interviews were semi-structured; similar to a format described by Neis *et al.* (1996, 1999). A questionnaire (see Appendix A) was used as a guide but additional discussion was encouraged. Spatial information was recorded on a Canadian Hydrographic Service nautical chart (chart number 4701, Ship Harbour Head to Camp Islands, 1:75000 scale) of the area, and a map of Gilbert Bay indicating local place names (Fig. 2). Fish harvesters were encouraged to discuss local fisheries and give their perspective of a potential MPA in Gilbert Bay.

## HABITAT SURVEY

Marine habitat descriptions vary depending on the type of data available. A brief visual survey was conducted using underwater video equipment to access differing habitat types. Different habitats were described including an Atlantic cod spawning site, identified by Morris and Green (unpublished data), scallop dredging site, and six other locations with varying depths and substrate types (Fig. 3). This component of the project explored the capabilities of underwater video equipment to describe Gilbert Bay's marine

habitat and possible effects of fishing gear. We tested visibility at depth, maneuverability, practicality, and amount of detail discernible from the video footage.

A Sea-view, black and white 150 model, underwater video camera was used to view substrate. A 50 m cable connected the underwater video camera to a recording camera (Sony CCD-TRV87 Handycam) at the surface. A 15-cm ruler, placed horizontally one meter in front of the underwater camera, was a reference for distance and size. Video transect locations were recorded on maps along with water depth, transect distance and duration. Video recordings were reviewed and habitat descriptions made. General substrate descriptions followed a format outlined by Wentworth (1922) with some modifications (Table 1).

## RESULTS

### FISH HARVESTERS REACTION TO THE INTERVIEW

Only one fish harvester refused an interview and for the most part interviews were interesting, informative and friendly. In general, fish harvesters were concerned about Gilbert Bay cod and wanted some level of protection. The initial reaction to the phrase, 'Marine Protected Area' was somewhat apprehensive. Fish harvesters initially questioned possible effects upon the scallop fishery, which was the largest commercial fishery in the area at the time of the interview. Fish harvesters appear to support the idea of a MPA for cod in Gilbert Bay, but are not supportive of a MPA that would restrict the scallop fishery at the present time.

### SCALLOP (*Chlamys islandica*) FISHERY

Fish harvesters in Gilbert Bay indicated that a single scallop-fishing crew consists of at least three people. Scallop dredges are towed back and forth in the same location, each tow lasting approximately 15 minutes. Some crews change their fishing location two or three times a day, while others drag continually in the same location until catches decrease. All fish harvesters interviewed, except one, were using Digby type scallop dredges (Fig. 4). One fish harvester had recently changed from Digby dredges to heavier and wider Labrador type dredges.

In Gilbert Bay, scallops are usually fished at depths from 8 m to 20 m, while depths greater than 40 m are seldom fished. Scallops in shallow water (< 14 m) were reported to have larger meats and thinner shells than scallops in deeper water. Scallop harvesters indicated that catch rates were greatest in areas with a gravel, cobble, and small boulder substrate, while fewer scallop were caught in areas with a mud/clay substrate.

Scallop harvesters reported that scallops could be found throughout Gilbert Bay and near its mouth (Fig.5). Williams Harbour Run (Fig. 2) was reported as an excellent scallop fishing location during the early 1990's. Three fish harvesters that have fished scallop in the area for the past ten years indicated that current fishing locations extend further into Gilbert Bay than in the early 1990's. One scallop harvester that fished only the outer part of Gilbert Bay and Alexis Bay from 1992 until 1999, began fishing near Middle Island in Gilbert Bay in 2000.

Fish harvesters suggest that 100 lbs. (45.5 kg) of scallop meat is a good days catch, while 50-65 lbs. (22.7–29.5 kg) of meat is perhaps the average (Table 2). A usual day of scallop fishing lasts between 10 and 14 hours. Each fishing season can last five months, beginning in June and ending in October. However, other fisheries influence scallop fishing in Gilbert Bay. For example, a decreased individual crab quota usually requires less time to catch, and thus more time is available to fish other species such as scallop.

For residents of Williams Harbour and Port Hope Simpson, the commercial scallop fishery in Gilbert Bay became an important source of income after the northern cod moratorium in 1992. Beginning in 1995 however, with the initial increase in Temporary Seasonal Permits for snow crab, some fish harvesters became more involved with crab than scallop. In 1997, temporary inshore shrimp allocations were introduced which further reduced scallop-fishing effort in the area. For fish harvesters with other licenses, scallop fishing was reduced to periods before and after other quotas were caught.

Since 1992, the size of fishing boats used by scallop harvesters in the Gilbert Bay area has increased (Fig. 6). Fish harvesters obtained larger boats to take part in crab and shrimp fisheries offshore. Equipped with larger fishing boats, fish harvesters were able to increase the number of scallop dredges (Fig. 7) used in Gilbert Bay. In 1992, most fish harvesters were using speedboats between seven and eight meters in length, capable of towing two scallop dredges. Today, most fish harvesters use larger boats, usually > 10.6 m (under 35 feet) long liner types, and tow 3-6 dredges simultaneously.

## SCALLOP ABUNDANCE

Interviews with fish harvesters indicated that overall scallop catches have been consistent over time. Use of more dredges today than in the past may offset a decrease in total catch. Since 1992, scallop harvesters have found several additional scallop beds, some of which are located near Middle Island and River Out. Local fish harvesters credited experience and increasing local knowledge of scallop beds with helping to maintain a stable catch rate. Two fish harvesters that have been fishing scallop the longest (10 yr.) report an obvious decrease in scallop abundance at areas where scallops were most abundant in the past, namely Williams Harbour Run and Main Tickle. Only one fisher, who has fished scallop since 1997, reported no decrease in scallop abundance at regular fishing locations.

Fish harvesters indicated they are not in favour of closing the scallop fishery in Gilbert Bay. The general rational for this is that since 1992, several fish harvesters moved into other fisheries such as crab and shrimp, and fishing pressure on scallop has dropped considerably. Scallop harvesters contend that while other fisheries are ongoing there will be a reduced scallop fishery in Gilbert Bay. Therefore, the area can continue to support a sustainable scallop fishery.

## MOVEMENT OF SCALLOPS

Several scallop harvesters reported fluctuations in abundance at particular fishing areas. They indicated that scallop catches at the beginning of each season were usually better than mid summer catches, from the same location. Two harvesters described changes in scallop abundance at different times during the season, and from day to day. They attributed changes in abundance to the movement of scallops.

## GILBERT BAY COD (*Gadus morhua*)

Local fish harvesters have long recognized that Gilbert Bay cod are distinguishable from other cod, such as offshore migratory cod, based on colouration differences. Fish harvesters speculate that the dark reddish-brown colouration of Gilbert Bay cod occurs as a result of their environment, possibly due to the brownish coloured water in the bay, or the type of bottom. One fish harvester stated that cod change their colour with time and that offshore cod become dark after spending some time in the bay, perhaps a year or so. This is a common explanation for the existence of Gilbert Bay cod among fish harvesters; a portion of offshore migratory cod move into Gilbert Bay in summer, they mix with the bay cod, and then over-winter in the Bay.

Of those persons interviewed, all but one suggested that Gilbert Bay cod be protected from commercial fishing. Five of the nine fish harvesters interviewed suggested the closure of Gilbert Bay to both the commercial and food fisheries. All fish harvesters interviewed indicated that Gilbert Bay cod were over-fished during the 1998 commercial index fishery. One fish harvester felt that, other than during 1998, fishing pressure was not reducing the cod population, the stock was in good health, and it could sustain a small commercial fishery. Most fish harvesters however, were concerned that if the population were not managed differently, it would become depleted. Additional monitoring was suggested as the best way to protect the population.

Fish harvesters who fished cod commercially in or near Gilbert Bay indicated that bay cod move to the outer part of Gilbert Bay in summer, mixing with migratory offshore cod at this time. During the traditional trap fishery, few Gilbert Bay cod were trapped outside of Gilbert Bay. Gilbert Bay cod were reportedly captured infrequently as far away as Copper Island, on the south side of Grandby Island, and George's Cove, on the

north side of Grandby Island (Fig. 2). One fish harvester indicated that bay cod were occasionally caught in trout nets in Alexis Bay.

Three fish plant operators who bought Atlantic cod from the Gilbert Bay area during the 1980's and early 1990's were interviewed. Each buyer indicated that Gilbert Bay cod were sometimes bought at the beginning of the fishing season, before the traditional cod trap-fishing season began. One buyer indicated that some fish harvesters near Gilbert Bay would have 5-10 quintals (500-1000 kg) of Atlantic cod on salt before the salmon season started in June-July. All three noted that a relatively small amount of bay fish was purchased each year. However, records of actual fish sales have long been destroyed. Fish buyers identified bay fish by their skin colouration, which was darker than fish caught at other locations along the Labrador coast. Two fish buyers indicated that Gilbert Bay cod were sometimes graded as cullage or as 'a number 2 fish'. This may have been a result of colour, but in general, they recalled no problems with the quality of Gilbert Bay cod.

Since the commercial scallop fishery developed in 1992, fish harvesters have observed Gilbert Bay cod feeding upon discarded scallop remains. Fish harvesters reported an abundance of cod at scallop dragging locations. There are mixed opinions as to whether cod actually follow fishing boats as they are dredging, or if cod remain in general locations where scallop fishing occurs.

## OTHER SPECIES

### *Whelk* (*Buccinum undatum*)

Along the Labrador coast, whelk is becoming a commercially important species. Whelks are described by fish harvesters as being more abundant along the headlands rather than within Gilbert Bay. Whelk pots were observed in Williams Harbour Run, and near Main Tickle (Fig. 2). Fish harvesters indicated that whelk are small and scarce in the inner part of Gilbert Bay, compared to other areas. Presently, the only direct commercial harvesting of whelk in Gilbert Bay occurs near the mouth.

### *Sea Urchin* (*Strongylocentrotus droebachiensis*)

Sea urchins are quite plentiful in parts of Gilbert Bay. Fish harvesters report a large number of sea urchins as bycatch in the scallop fishery. Currently there is no market for sea urchins in this area and they are discarded.

***Sea Cucumber (Cucumaria frondosa)***

Sea cucumber was identified as being abundant at some locations in Gilbert Bay. If a suitable market was available, this species could have commercial importance in this area. Two fish harvesters reported that sea cucumbers were abundant at Winnard Tickle (Fig. 2). Currently, there is no market for sea cucumber in Atlantic Canada, and bycatches of sea cucumber are discarded.

***Lumpfish (Cyclopterus lumpus)***

Lumpfish was identified as having potential commercial importance, but fish harvesters did not indicate an abundance of lumpfish in Gilbert Bay. One lumpfish was observed in Williams Harbour Run (Fig. 2) using the underwater video camera. Presently, there is no commercial fishery for lumpfish in the area.

***Capelin (Mallotus villosus) and Herring (Clupea harengus)***

Fish harvesters report that herring and capelin are sometimes found in Gilbert Bay. Herring have reportedly been caught in Gilbert Bay during spring and fall, particularly at Deer Park (Fig. 2). One interviewee indicated that herring spawn in Deer Park. Local fish harvesters have also observed capelin in Gilbert Bay. One fish harvester indicated that capelin sometimes spawn in shallow water near River Out. Fish harvesters interviewed have not observed capelin spawning on beaches in Gilbert Bay in recent years.

***Rock Cod (Gadus ogac)***

Rock cod was reported as abundant near the outer part of Gilbert Bay, along the coast, and in neighbouring bays. This species was fished commercially to a limited extent in the 1980s and could have commercial importance in the future.

***Snow Crab (Chionoecetes opilio)***

Snow crab was reported as scarce in Gilbert Bay. More snow crab was reported in Alexis Bay than Gilbert Bay. Snow crab has been caught in the deepest areas of Gilbert Bay located near The Turn and inside Middle Island.

## HABITAT SURVEY

Table 3 describes substrate at a popular scallop-dredging site in Gilbert Bay. At this site the bottom is generally flat with few boulders, except close to shore. It is difficult for fish harvesters to drag scallops close to shore because of the steep slopes and large boulders. Approximately 100 m from shore boulder/cobble substrate is predominating. A substantial portion of the substrate in this area consists of a sandy bottom intermixed with small boulder and cobble. On a sandy substrate, marks left by scallop dredges were easily identified by small piles of sediment along the edges of a dredge path.

Table 4 describes substrate at a cod spawning site in The Shinneys. At this location the substrate consists of various size boulder and silt. Coralline alga was generally associated with boulders in this area. Gilbert Bay cod at this site, as well as at other locations, were frequently observed in areas having large boulders.

Various habitat types with a wide range of epifauna are described at six locations in Gilbert Bay (Table 5). The maximum depth visible in Gilbert Bay using this camera was approximately 35 m. At this depth little detail could be observed. The camera was tested at other locations including Trinity Bay and Nortre Dame Bay (both located on insular Newfoundland), where visibility was much better. At these locations substrate was clearly visible at 50 m. Reduced visibility in Gilbert Bay is likely a result of fresh water runoff from the Shinneys and Gilbert Rivers. Surface water in Gilbert Bay is dark brown in colour and probably reduces light penetration.

# DISCUSSION

## INTERVIEWS

Gathering potentially sensitive fishery information, such as catch rate and effort data, through interviews with fish harvesters may be more problematic for DFO personnel than for individuals not involved in the regulations, management, or deployment of fisheries (Hutchings and Ferguson 2000). Although there were times of hesitancy on behalf of fish harvesters to answer particular questions relating to the fishery, it did not appear to affect the interview. If the interviewee did not want to discuss a particular topic it was not addressed. This approach was taken as not to deter the interviewee or obtain inaccurate responses.

Interviews can effectively gather information from a specific audience that may not always become involved in public consultations but have a vested interest in the area in question. Several fish harvesters indicated they were reluctant to speak at public meetings held by DFO in Port Hope Simpson and Williams Harbour regarding the MPA initiative. Interviews provided an additional opportunity for fish harvesters to discuss their opinions of a MPA in a more private and informal setting than a public meeting.

During interviews, fish harvesters appeared to have just as many questions as the interviewer about Gilbert Bay cod and the role of a MPA in relation to commercial fishing activities. After an interview was completed, there was usually an opportunity to talk with fish harvesters and answer many of their questions regarding the MPA Program under the *Oceans Act.*

## SCALLOP FISHERY

At the present time, scallop fishing is the primary fishery in Gilbert Bay. Scallop fishing in Gilbert Bay is an open fishery, not governed by quota or limited to a particular number of boats. The scallop fishery in Gilbert Bay may last throughout the ice-free season from mid-May until late October. However, the amount of time scallop harvesters spend fishing in this area has decreased with the arrival of other fisheries, primarily for crab and shrimp. Temporary crab and inshore shrimp licenses were issued since 1995 and 1997 respectively (Jacqueline Perry, DFO, Northwest Atlantic Fisheries Centre, P. O. Box 5667, St. John's, NF A1C 5X1, Pers. Comm.). Out of the nine fish harvesters interviewed, four had temporary crab licenses, and were preparing to take part in that fishery. Nine other local fish harvesters were not available for an interview because they were fishing crab or shrimp offshore, or fishing scallop elsewhere in Labrador, when interviews were conducted.

Fish harvesters reported that during the late 1990's fewer people fished scallop commercially in Gilbert Bay than during the early 1990's. Reduction in the number of fish harvesters and the amount of time individuals spend scallop fishing, has reduced the overall fishing effort in Gilbert Bay. However, changes in fishing methodology such as bigger boats and increased number of dredges has increased individual effort. Fish harvesters supported the continuation of a local scallop fishery and indicated that fewer fish harvesters has made the stock more sustainable. However, if there is a significant decrease in crab or shrimp quotas, fewer temporary licenses may be issued. In this situation, fish harvesters could return to the scallop fishery in Gilbert Bay. Therefore, future management plans for Gilbert Bay should consider the effect of increased scallop fishing, and consider methods to increase scallop abundance.

Interviews did not obtain much detailed information concerning substrate type or the effects of scallop fishing on bottom habitat. Scallop harvesters and video imagery indicated that scallop are most commonly fished in areas with cobble, gravel, small boulder and coralline algae substrate. Limited information from scallop harvesters may have been a result of inadequate questioning, or hesitancy on behalf of scallop harvesters. Gravel habitat with a high diversity of encrusting species is particularly sensitive to scallop dredging which removes the attached epifauna, reducing habitat complexity and species diversity (Dayton *et al.* 1995). Many benthic species affected by scallop dredging include polychaetes, shrimps and brittle stars (Collie *et al.* 1996), which are important food sources for Gilbert Bay cod (Morris 2000). There is limited scientific information related to habitat, scallop abundance, and the effects of scallop fishing gear in Gilbert

Bay. Additional research may assist in identifying and protecting sensitive habitat, such as scallop spawning areas, increasing spat production, and development of fishing methodologies beneficial to the scallop fishery.

## SCALLOP ABUNDANCE

A scuba survey conducted by Fletcher *et al.* (1975) describes marine resources and some physical characteristics of the Gilbert Bay area. This survey, conducted in Gilbert Bay between July 14, and August 21, 1974, noted a moderate abundance of Iceland scallop scattered throughout Alexis Bay and Gilbert Bay. Areas of highest scallop abundance observed by Fletcher *et al.* (1975), at a depth of 16.5 m, were Williams Harbour Run, Rexon's Point and close to shore between River Out and Peckham's Cove (Fig. 2). Iceland scallop can be found as deep as 1440 m (Allen 1965), therefore, estimates based on a scuba survey to a depth of approximately 16.5 m may not represent the true population density within the bay. However, scallop harvesters in the area have confirmed those areas identified by Fletcher *et al.* (1975), to have a high density of scallop, compared to other locations in the bay. Fletcher *et al.* (1975) found that approximately 50 scallops from Alexis Bay, with a shell length of 7 cm (8 yr. old), produce 1 lb. (.45 kg) of meat. Based on this estimate, on a good day a single crew that catches 100 lbs. (45.5 kg) of scallop meat could catch as high as 5000 scallops; a single crew may catch 3000 scallops during an average day.

Scallops are generally found throughout Gilbert Bay, however, it appears that fish harvesters today travel further distances to fish scallops than in the past. During a visit to Gilbert Bay, while conducting interviews, we observed five boats fishing scallops between Kelly's Point and River Out (Fig. 2) and only one boat fishing in Williams Harbour Run. Since 1992, there appears to have been a spatial shift in the scallop fishery, in which scallop harvesters have moved further into Gilbert Bay. Today, it seems that scallop harvesters are fishing in areas toward Kelly's Point and Middle Island more than in Williams Harbour Run or Main Tickle. These changes in fishing locations suggest that Williams Harbour Run may not yield catches as large as that in other areas.

## SCALLOP MOVEMENT

Scallop harvesters in the Gilbert Bay area have suggested that scallops change their location. However, the scientific literature does not support that Iceland scallops migrate from one area to another, over short or long periods. Studies indicate that these scallops are sedentary and in most cases do not move at all (Posgay, 1980; Sam Naidu, DFO, Northwest Atlantic Fisheries Center, P.O. Box 5667, St. John's, NF A1C 5X1, pers. comm.). Sea scallops (*Placopecten magellanicus*) can be quite active (Posgay 1980) and may sometimes be seen 'swimming' a short distance from the bottom. This occurs mainly when sea scallops are small. Iceland scallops however, are often attached

to the substrate (Gruffyd 1976). Nonetheless, fish harvesters in the Gilbert Bay area and from other locations (Posgay 1980) assert that scallops change location.

## GILBERT BAY COD

Fish harvesters are greatly concerned over the status of Atlantic cod in Gilbert Bay. Their concerns stem from commercial fishing activities that have occurred in Gilbert Bay since the northern cod fishery re-opened, particularly during the 1998 commercial index fishery. Under inland waters regulations fishing is not permitted in two areas of Gilbert Bay (Fig 8.). Fishing has not been permitted in these areas since the early 1990's (Carl Bradley, DFO, P.O. Box 105, St. Lewis, Labrador, AOK 4WO, pers. comm.). An additional portion of Gilbert Bay was closed to cod fishing by a fisheries variation order after the commercial index fishery closed in 1998 (Fig. 8). These fishing area closures are providing a level of protection to the Gilbert Bay cod population.

Movement patterns of Gilbert Bay cod as described by fish harvesters were often similar to scientific findings. Fish harvesters indicated that Gilbert Bay cod move to the outer part of the bay during summer and back into the bay during winter. The annual movement patterns of sonically tagged cod in Gilbert Bay described by Green and Wroblewski (2000) and commercial tag return data (Morris and Green [unpublished data]) indicates that cod stay in Gilbert Bay year round. Both scientific findings and local knowledge suggest that the range of Gilbert Bay cod does not extend far beyond the mouth of Gilbert Bay.

Historically, a portion of northern cod migrated inshore in summer to feed and returned offshore in fall to overwinter and spawn (Lear 1984; Lear and Green 1984; Postolaky 1968; Serebryakov 1965). Northern cod that migrate from offshore to inshore annually mix with Gilbert Bay cod in summer. Local fish harvesters suggested that some offshore cod overwinter in Gilbert Bay. However, scientific studies suggest it is unlikely for any offshore cod to overwinter and spawn successfully in Gilbert bay. The genetic differences observed by Ruzzante *et al.* (2000) imply that reproductive mixing has been limited for some time. Otherwise, genetic differences would not be as apparent. Movement patterns of Gilbert Bay cod and other northern cod also indicate that they spawn in separate areas. Fish harvesters were very interested in some of the scientific findings related to cod in Gilbert bay, and accepted the possibility that Gilbert Bay cod comprised an isolated population. Identifying Gilbert Bay cod as being separate from offshore cod has increased the acceptance for protecting this population.

During the scallop fishing season cod are often abundant near scallop dredging locations. Morris (2000) reported that the food items consumed by cod at these locations included scallop discards, from processing scallops at sea, as well as the commercially important adductor muscle. Scallop dredging may break open some scallop shells making the contents, including the adductor muscle, available to cod. The additional food from scallop fishery discards and crushed scallops may provide food to several

Gilbert Bay cod during the scallop fishing season, and possibly attract cod to particular locations throughout the bay. At locations where there was no scallop dredging, the cod diet consisted primarily of other benthic food items (Morris 2000).

## HABITAT SURVEY

Habitat descriptions included in this report provide a superficial description of substrate at selected locations. The amount of video data collected was limited by time restraints and equipment malfunctions. The amount of video did not provide enough information to make comparisons with habitat data collected from interviews with scallop harvesters. However, video information suggested that it is possible to describe scallop abundance and habitat alterations due to scallop dredging gear with underwater video. The Sea-View underwater video camera may be useful in the future to investigate the effects of scallop fishing on benthic habitat and to conduct further habitat descriptions.

The camera system worked well in depths less than 8-10m and its operation is feasible at a relatively low cost, compared to scuba studies in remote locations which are expensive and logistically difficult. Video imagery collected with this camera is sufficient to classify habitat and identify benthic organisms that are greater than approximately 5 cm in size. Controlled maneuverability became increasingly difficult with depth. Wind and tides also reduced the ability to control and maintain position of the camera. A display of depth and global positioning coordinates on screen with the video imagery would improve the processing of video information

## FUTURE CONSIDERATIONS

There is concern from fish harvesters regarding the future of the commercial scallop fishery in Gilbert Bay. Undoubtedly, there is scientific research indicating the destructive nature of bottom dredging on benthic habitat. However, several methods are available to mitigate against habitat alteration and decreasing scallop stocks such as rotating area closures, identifying and protecting spawning beds, and larval enhancement. In the future MPA managers should meet with fish harvesters and discuss possible ways to maintain an adequate scallop fishery with minimal habitat alterations.

A better understanding of benthic habitat and hydrographic conditions in this area could benefit the MPA program and the scallop fishery. For example, hydrodynamic conditions of the area could determine if scallop spat from particular areas within Gilbert Bay are seeding the surrounding area. If so, scallop in Gilbert Bay may act as brood stock, seeding areas outside of potential MPA boundaries. The possibility of increasing the longevity of the scallop fishery via a no fishing zone may increase the acceptance of an MPA. It is helpful to consider the benefit of MPA's in terms of trade-offs between long term protection of rich ecological resources and their immediate use for economic gain (Sumaila *et al.* 1998).

Fish harvesters in the Gilbert Bay area were concerned about the status of cod in the bay, indicating that the stock size was probably reduced since commercial fishing resumed in 1998. However, the number of Gilbert Bay cod is unknown and conducting a population estimate should be a focus of future research in this area. Measuring changes in the population structure may also allow a better understanding of this population. A fisheries variation order implemented by DFO in 1998 under the Fisheries Act, restricts recreational and commercial fishing in part of Gilbert Bay and has provided at least some refuge for Gilbert Bay cod during the 1999-2001 commercial and recreational fisheries.

Interviews provided valuable fishery information not available from other sources. A general lack of connectivity between local and scientific knowledge was perhaps do to the limited amount of scientific information known about study area. Where scientific information did exist there was some agreement with traditional knowledge. The brevity and small number of interviews likely did not allow for as much overlap between local and scientific knowledge as we believe is possible. To broaden our understanding of local knowledge and better understand its usefulness in relation to science, we suggest follow up and additional interviews with local fish harvesters. The MPA program of DFO is designed to work in collaboration with local interest groups, and where fishery resources are concerned, interviews with local fish harvesters are an effective method to do just that.

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Table 1. Substrate description, following Wentworth (1922), with some modification

| Substrate | Description |
|---|---|
| Silt | Unpacked particles with diameter < 0.0625 mm |
| Mud | Packed particles with diameter < 0.0625 |
| Sand | Particles with diameter > 0.0625 mm and < 2.0 mm |
| Gravel | Particles with diameter > 2.0 mm and < 64.0 mm |
| Cobbel | Particles with diameter > 64.0 mm and < 150 mm |
| Small boulder | particles with diameter > 150 mm and < 300 mm |
| Medium boulder | Particles with diameter > 300 mm and < 600 mm |
| Large boulder | Particles with diameter > 600 mm |
| Bedrock | Solid rock substrate |

Table 2. Reported daily catch of scallop from Gilbert Bay, as indicated by fish harvesters.

| Unique identifier | Scallop meat (lbs.) good day | Scallop meat (lbs.) average day | Fishing effort per day (hrs) |
|---|---|---|---|
| 1 | 100 | 50 | 12 |
| 2 | 100 | 70 | 12 |
| 3 | 120 | 80 | 14 |
| 4 | | 65 | 10 |
| 5 | 100 | 50 | 10 |
| Mean | 105 | 63 | 11.6 |

Table 3. Benthic description at a scallop dredging site (Fig. 3), Gilbert Bay.

| Transect number | Transect site description | Transect distance (m) | Depth (m) | Substrate description | Estimated scallop density ($m^2$) |
|---|---|---|---|---|---|
| 1 | 30 m from shore, along the bottom of a steep gradient. Difficult area to fish scallop. | 1 to 80 | 10 to 12 | Cobble (50%), sand (25%) and boulder (25%) substrate<br>Sparse corline alga<br>Scallops relatively abundant | 0.47 (1-80 m) |
| | | 80 to 120 | 8 | Large boulder outcropping<br>Abundant corline alga, bryozoans, sponge<br>Shrimp, scallops (few), cod, sea stars, sea anonomes, sea urchins | |
| | | 120 to 200 | 12 | Gravel (25%), cobble (75%) and boulder (25%) substrate<br>Sparse corline alga<br>Scallops and scallop shells, relatively abundant | |
| 2 | 200 m from shore, flat area. Easily accessible to scallop dredging. | 1 to 80 | 18 | Sand (80%) and boulder (20%) substrate<br>Coraline algae associated with large boulders<br>Sea urchins generally few, occuring in small dense (9 / $m^2$) patches<br>Rock crab and scallop (few), 1 flatfish | 0.18 (1-80 m) |
| | | 80 to 100 | 18 | Cobble and small boulder substrate<br>Sparse corline algae<br>Scallop | |
| | | 100 to 120 | 18 | Silt (80%) and boulder (20%) substrate<br>Little corline algae<br>Several holes in substrate, possibly clams | |
| 3 | 400 m from shore, flat area. Easily accessible to scallop dredging. Poor visibility, possibly affected identification of scallop. | 1 to 200 | 25 to 30 | Silt (50%), cobble (25%) and Boulder (25%) substrate.<br>Abundance of sea anomone associated with large boulders<br>Few scallops, sea stars, sea urchins, or crab observed | 0.29 (1-200 m) |

Table 4. Benthic description at an Atlantic cod spawning site (Fig. 3), Gilbert Bay.

| Transect number | Distance along transect (m) | Depth (m) | Area description and substrate type |
|---|---|---|---|
| 1 | 1 to 5 | 1 to 4 | Bedrock outcropping, steep slope with boulders<br>Boulders 80% covered with coralline alga |
| | 5 to 100 | 4 to 7 | Cobble and boulder substrate<br>Substrate 80% covered with coralline alga<br>Epifauna primarily consisting of sponge, bryozoans, and sea anemone |
| | 100 to 120 | 3 to 7 | Cobble and small boulder substrate<br>Substrate 80% covered with coralline alga<br>Epifauna primarily sponge, sea stars |
| | 120 to 200 | 6 | Silt (40%), gravel (20%), and cobble (40%) substrate<br>Sparse coralline algae<br>Epifauna consists mainly of sea stars |
| 2 * | 1 to 100 | 8 | Primarily silt substrate with several large boulders<br>Sparse coralline algae overgrowing large boulders<br>Few sea stars, few sea anemone |
| | 100 to 120 | 3 to 7 | Medium and large boulder substrate<br>Substrate covered (80%) with coralline alga<br>Epifauna primarily sponge, sea anemone, sea stars |

* Transect 2 parallels transect 1 approximately 100 m apart

Table 5. Benthic description at six different locations in Gilbert Bay. Sample locations are indicated on Fig. 3.

| Location | Transect distance (m) | Depth (m) | Area description and substrate type |
|---|---|---|---|
| North side of middle island | 50 | 15 | Flat bottom. predominately silt substrate |
| South side of Gilbert Bay near Middle Island | 120 | 15 | Flat bottom, mixture of boulder and cobble<br>Sparse coralline alga |
| Green Island | 50 | 8 to 12 | Boulder and gravel substrate with sparse coralline alga<br>Few sea urchins occurring only in patches (5 / $m^2$) |
| River Out | 5 | 34 | No detail was observed at this depth |
| Entrance to Snooks Arm | 50 | 3 to15 | Narrow passage with steep sloping sides<br>Large boulder substrate to a depth of 15 m<br>Boulders densely covered with epifauna consisting of<br>star fish, sea anenome, sponge, bryozoans,<br>sea urchins, coralline alga.<br>At 15 meters the bottom is flat with a high density of sea urchins<br>(6 - 10 / $m^2$) and covered with mussel shells. Cod were observed in this area |
| Entrance to Shinneys | 10 | 15 | Flat rocky substrate, densely covered with coralline alga<br>few sponge, scallop and sea anemone<br>Cod were observed in this area |

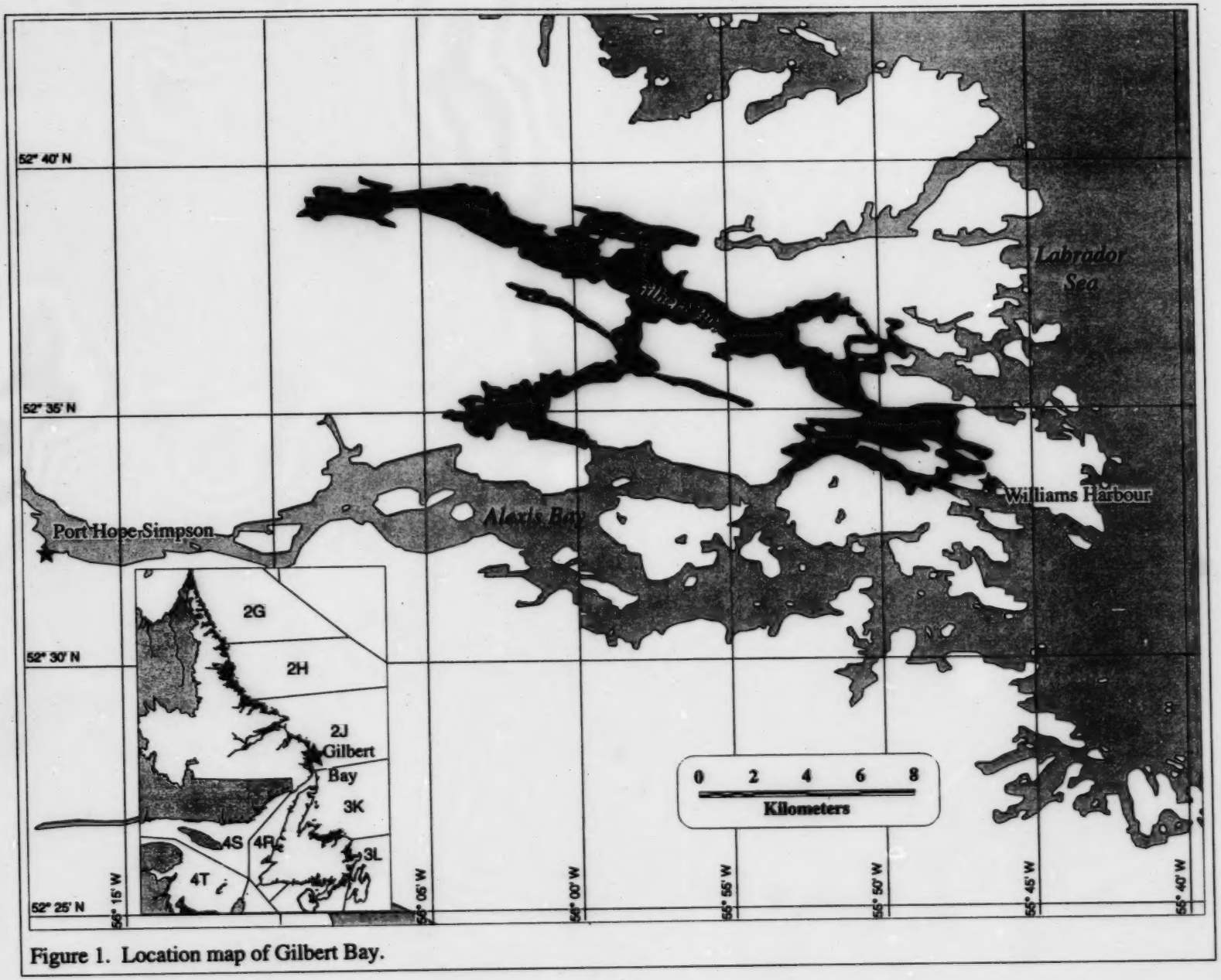



Figure 1. Location map of Gilbert Bay.

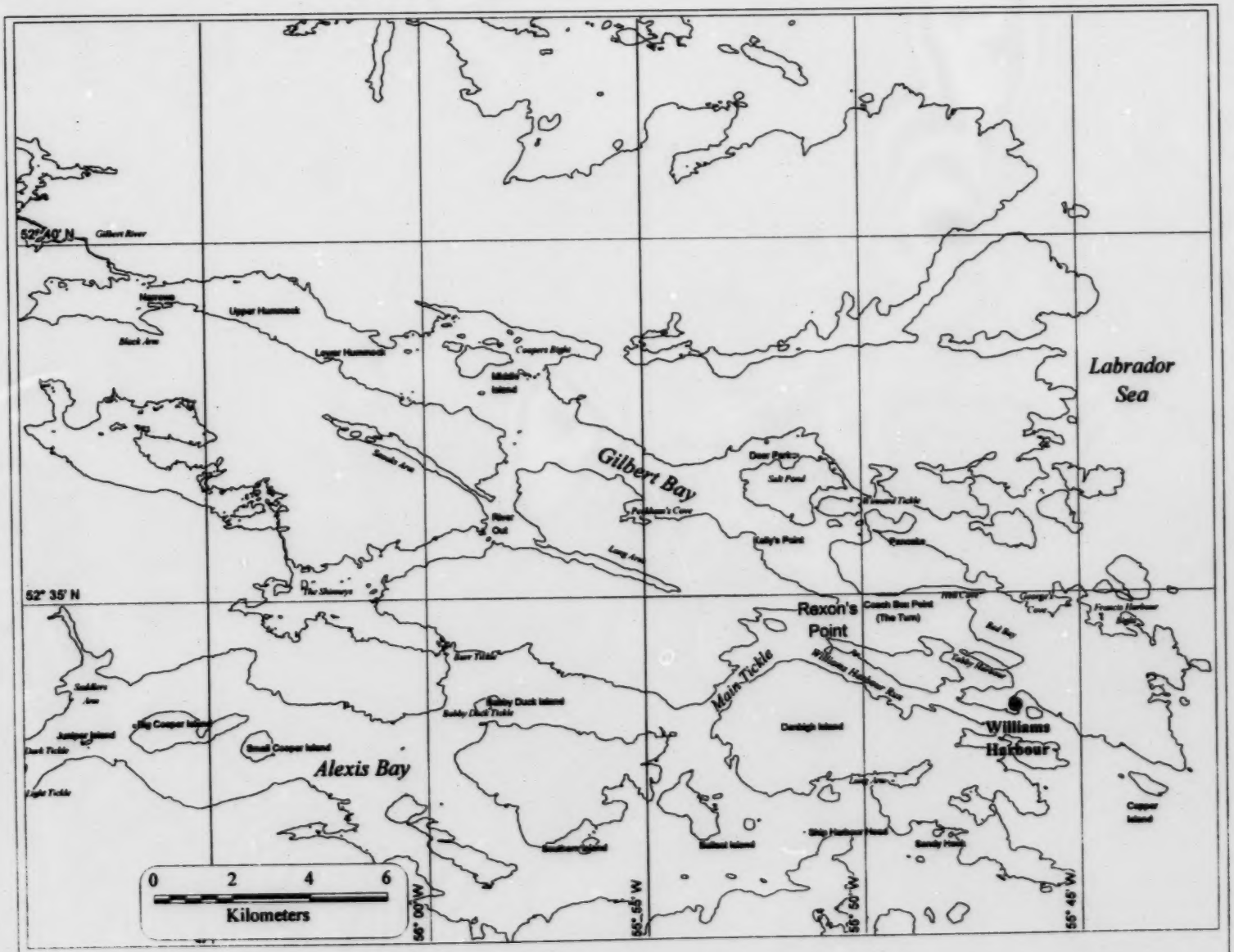



Figure 2. Local place names in Gilbert Bay.

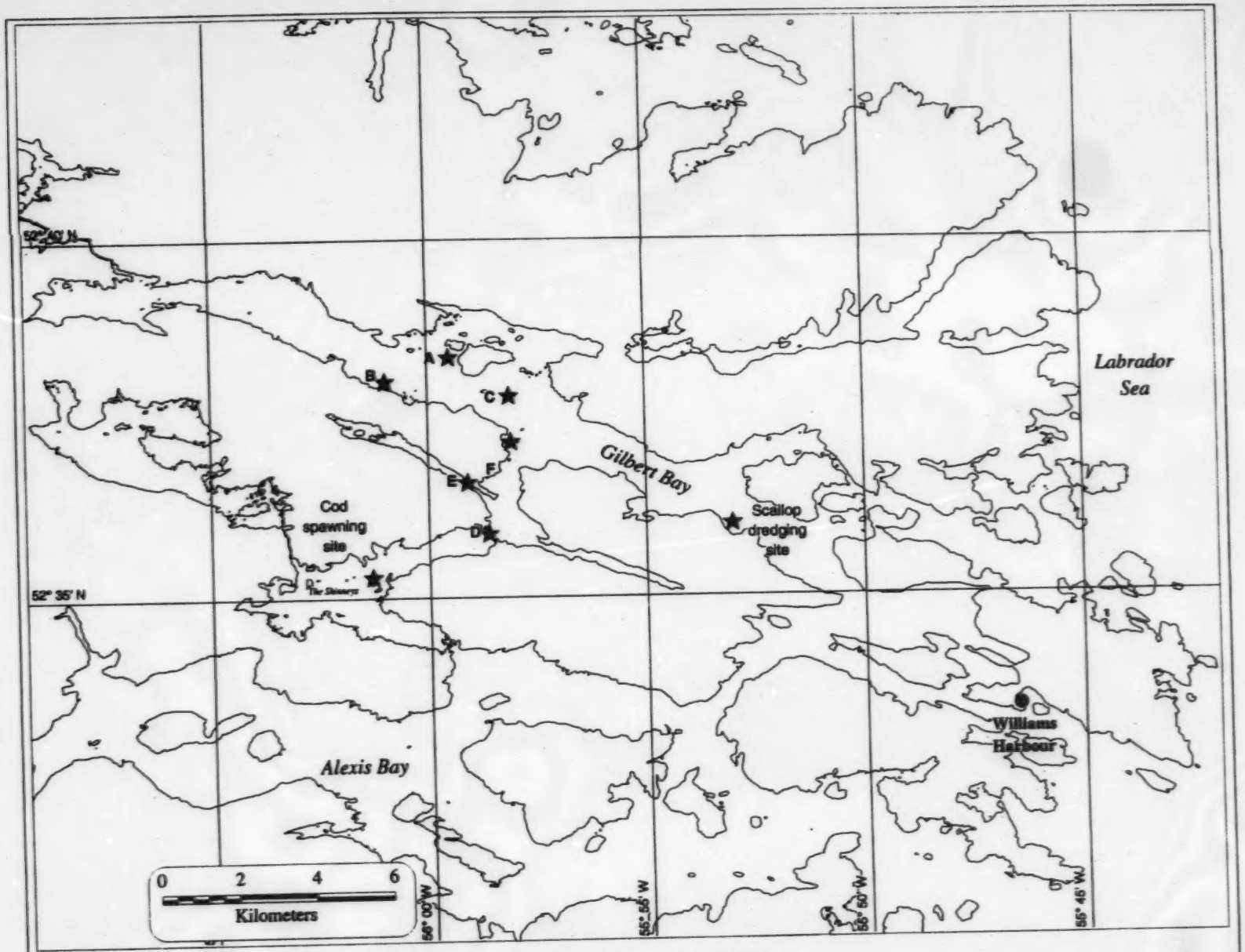
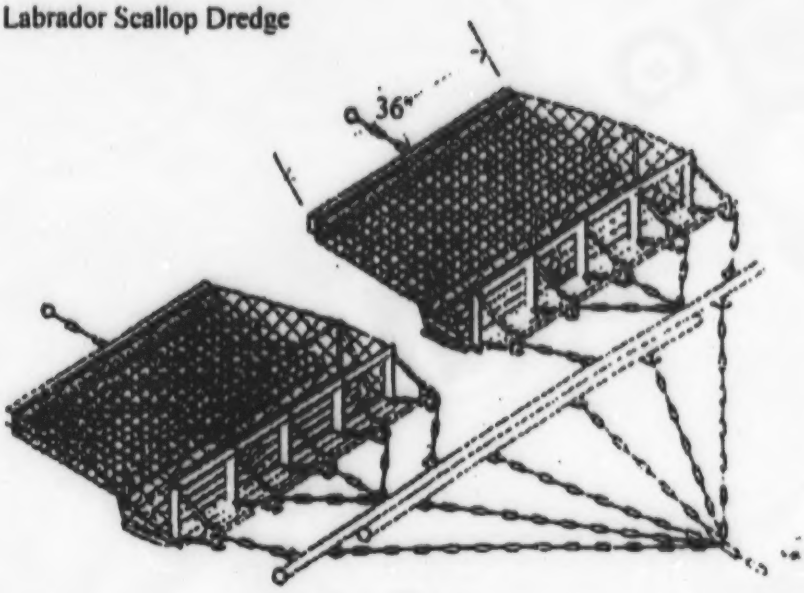



Figure 3. Locations sampled using the Sea-view underwater camera, Gilbert Bay

Labrador Scallop Dredge




Digby Scallop Dredge

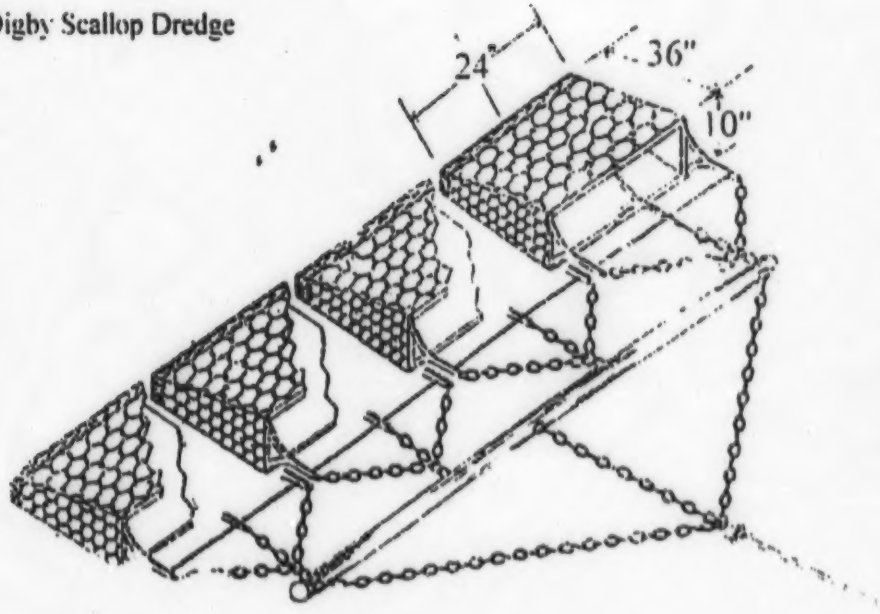



Figure 4. Scallop dredges used in Gilbert Bay.

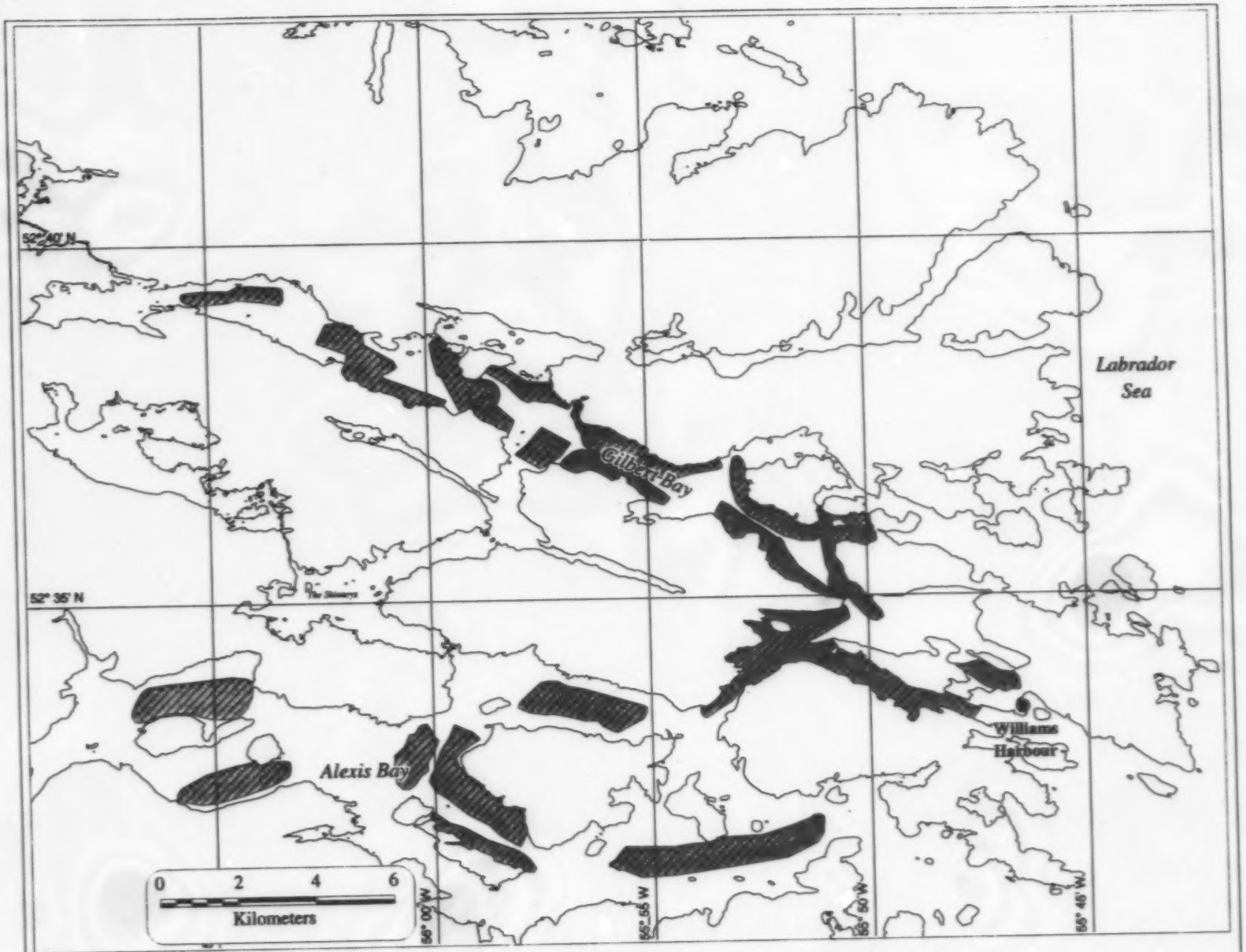



Figure 5. Scallop fishing locations identified by scallop harvestors (fishing areas are indicated in red).

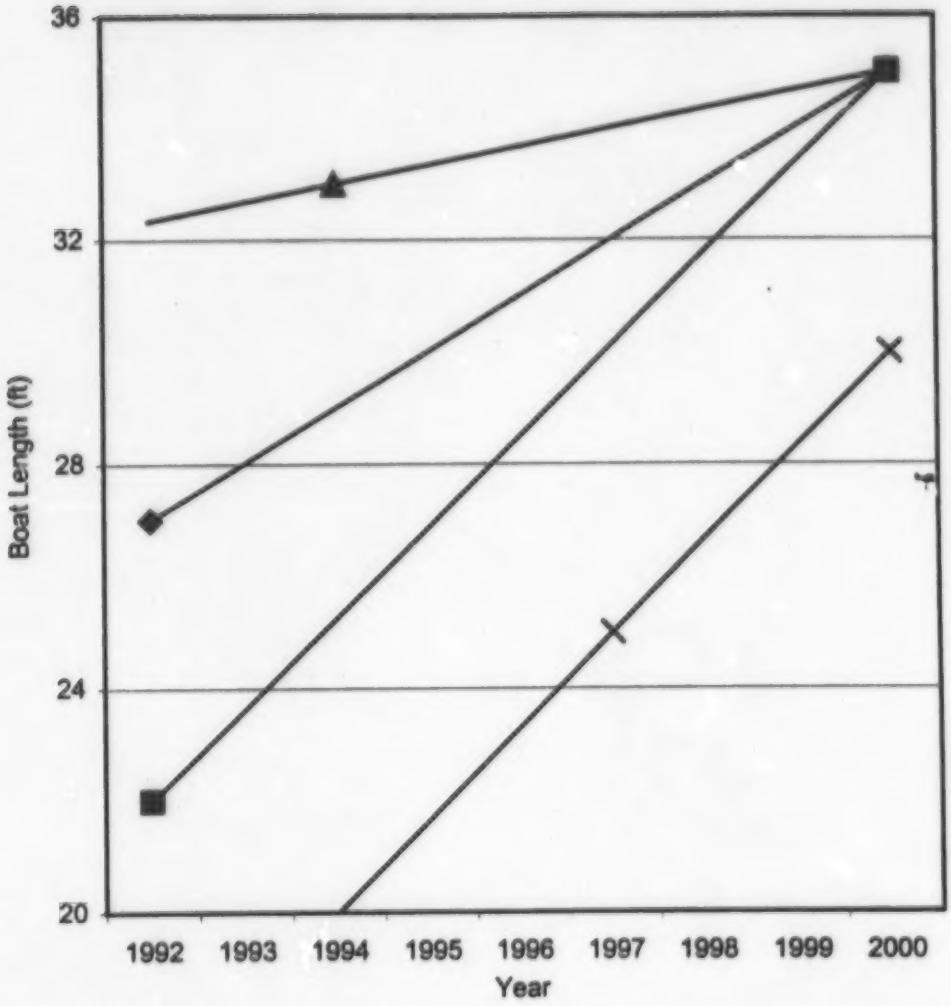



Figure 6. Change in boat size used by individual scallop harvesters. Each line represents change in boat length, based on boat length during the individuals first year of scallop fishing and boat length used in 2000.

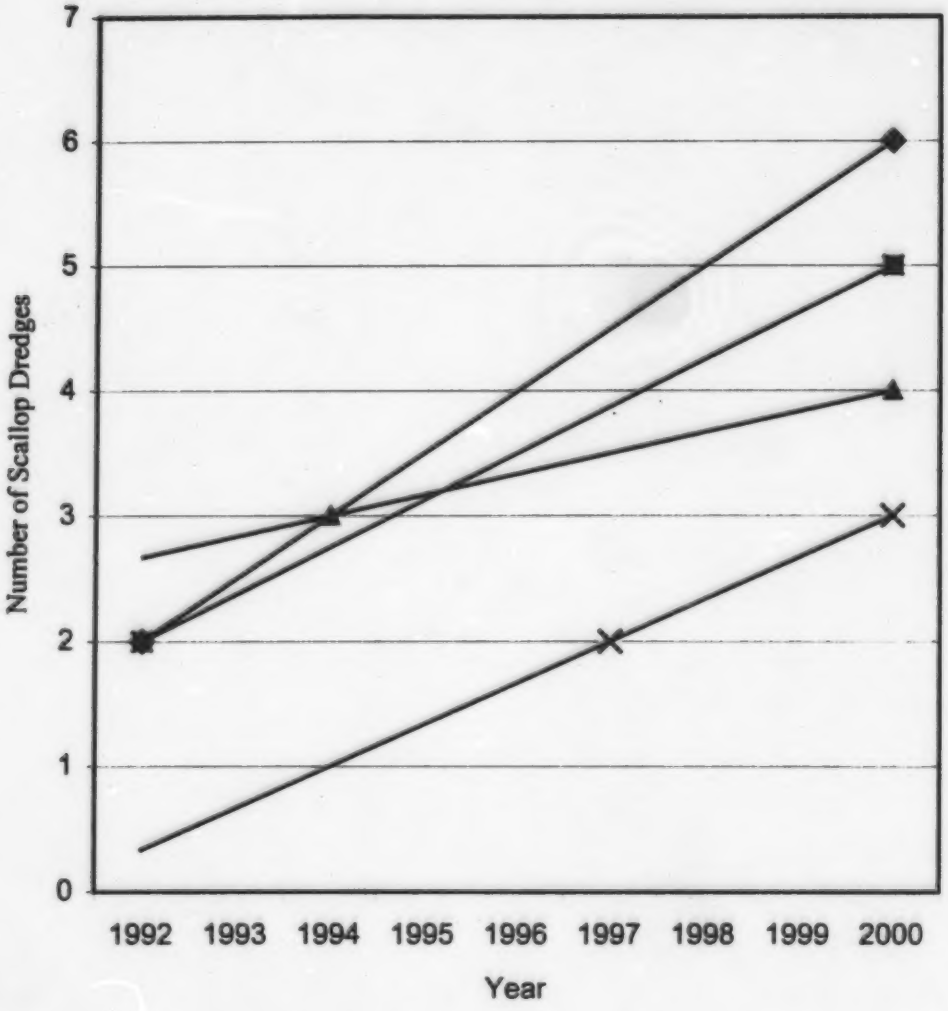



Figure 7. Change in fishing effort described by an increase in the number of scallop dredges used over time. Trend lines indicate an increase in fishing effort by individual scallop harvesters from the time they started fishing scallop until present.

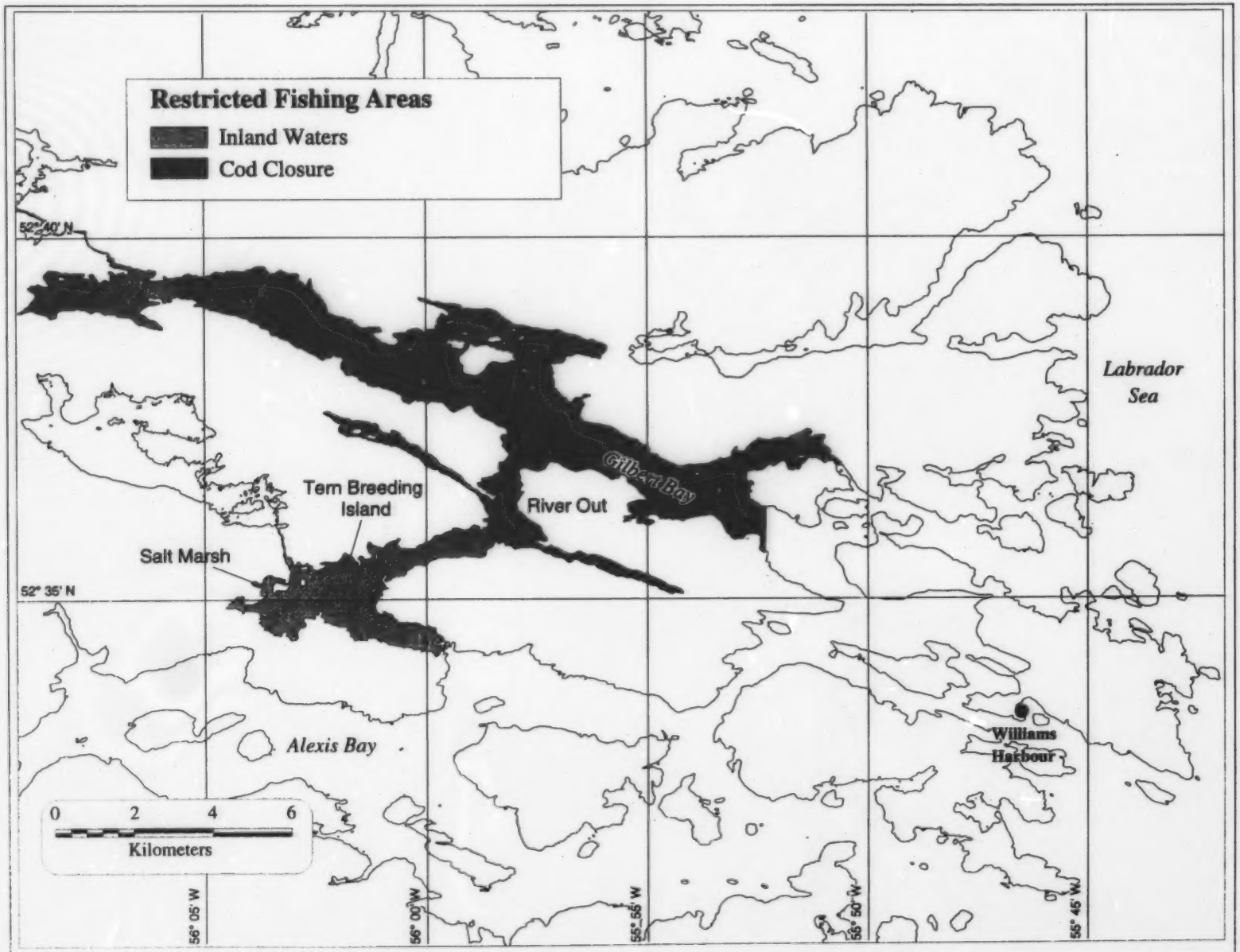



Figure 8. Restricted fishing areas in Gilbert Bay.

## APPENDIX A: INTERVIEW QUESTIONNAIRE.

**CONTACT INFORMATION:** Name, Address, Date.

**BACKGROUND INFORMATION**

1. How long have you been fishing?
2. Have you fished primarily in this area?
3. Have you ever fished commercially in Gilbert bay? If so, for what species? (Cod, Scallops, Crab, whelk, other)
4. What kind of boat due you use?
5. How many people fish as part of the crew?

**SCALLOP FISHING**

6. Have you fished scallops in or near Gilbert Bay?
7. During what years have you fished for scallop?
8. What type of boat did/do you use for scallop fishing?
9. When you first fished scallop in Gilbert Bay, in what areas did you fish?
10. As time progressed did your fishing locations change? If so, what new areas did you fish?
11. In what areas have you fished for scallop but were unsuccessful?
12. What areas would you consider to have the most scallop?
13. Have you observed changes in the scallop fishery since you started fishing in the area?

**FISHING METHODOLOGY**

14. What is your typical daily fishing schedule?
15. What is the length of the fishing season?
16. Can you describe your fishing method?
17. Are the same area fished day after day?
18. How often are fishing locations changed?
19. On average how much scallop (by weight) is caught per day? What would be a good, average, and poor catch per day?
20. Can the same area be fished from one year to the next, and produce a similar number of scallops?
21. Have you observed the size of scallops to change since you started scallop fishing? Are larger scallops found in some areas than others?
22. Are you catching more or less small scallops now than in the past?

**HABITAT MAPPING**

23. Can you identify areas that are Rocky (R), have live rock (LR), sand (S), mud (M), silt (SL)?
24. Can you identify areas where the type of bottom changes?
25. Can you indicate on the map, areas having the same type of bottom?

**OTHER SPECIES**

26. What areas in Gilbert bay produce a large number of whelks?
27. Do you consider areas of Gilbert Bay to have a large number of whelks compared to other areas?
28. What areas in Gilbert bay produce a large number of sea urchins?
29. Do you consider areas of Gilbert Bay to have a large number of sea urchins compared to other areas?
30. What other species do you think may be collected commercially, in Gilbert Bay?
31. Are there locations are these species abundant?
32. In what locations are theses species absent?

COD

33. Have you fished cod in Gilbert Bay, in the past or since the moratorium?
34. During what years did you fish in this area?
35. Have you ever observed capelin in the stomach of cod? If so where?
36. Have you ever observed capelin in Gilbert Bay? If so where?
37. Have you ever observed herring in Gilbert Bay or in the stomach of Gilbert Bay cod? If so where?
38. What time of the year and in which locations did you fish in this area? What type of fishing gear did you use?
39. Have you observed cod to follow the boat as you drag scallops?
40. Have you observed cod to eat scallop guts or the scallop meat?

**OPINION**

41. Have you spoken with scallop fishers from other areas, such as St. Michael's bay? If so, how would you compare Gilbert Bay, or your fishing areas, to other areas?
42. At the current harvesting level do you think scallops can sustain themselves, or are they being depleted?
43. Do you think that scallop fishing is harmful to the bottom?
44. Do you think that continued commercial cod fishing in Gilbert Bay will reduce the cod population in Gilbert Bay?
45. Due you suspect that a continued food fishery in Gilbert Bay will reduce this population?
46. Due you think there are more fish in Gilbert Bay now than before the closure of the cod fishery in 1992?
47. What is your opinion about a Marine Protected Area in Gilbert Bay?

**APPENDIX B. Benthic invertebrates collected during dredge surveys in Gilbert Bay, 1998.**

| Phylum | Class | Order | Family | Genus and Species | common name |
|---|---|---|---|---|---|
| Mollusca | | | | | |
| | Gastropoda | | | | |
| | | | | *Epitonium sp.* | wentletraps |
| | | | | *Littorina spp.* | periwinkels |
| | | | | *Lora sp.* | |
| | | | | *Margarites groenlandica* | pearly top shells |
| | | | | *Margarites helicina* | pearly top shells |
| | | | | *Solariella infundibulum* | |
| | | | | *Trichotropis borealis* | northern hairy-keeled snail |
| | | | | *Traphon clathratus* | |
| | | | | *Lunatia sp.* | northern moon shell |
| | | | | *Aemaea testudinalis* | |
| | | | | *Velutina sp.* | |
| | | | | *Ischnochiton ruber* | Red chiton |
| | | | | *Ischnochiton alba* | white chiton |
| | | | | *Tonicella marmorea* | mottled chitin |
| | Pelecypoda | | | | |
| | | | | *Astarte subaequilatera* | |
| | | | | *Mya arenaria* | soft-shelled clam |
| | | | | *Nuculana tenuisulcata* | nut shell |
| | | | | *Saxicava artica* | surf clam |
| | | | | *spisula solidissima* | surf clam |
| | | | | *Yoldia spp.* | yoldias |
| Annelida | | | | | |
| | Polycheata | | | | |
| | | | | *Pectinaria gouldii* | trumpet worms |
| | | | | *Leoidonotus squamatus* | |
| | | | | *Nereis pelagica* | clam worms |
| | | | | *Terebellides stroemi* | |
| Arthropoda | | | | | |
| | Crustacea | | | | |
| | | Amphipoda | | | |
| | | Hyperidae | | | |
| | | | | *Hyperia sp.* | big-eyed amphipods |
| | | Gammaridea | | | |
| | | | | *Ampithoe rubicata* | tube maker amphipod |
| | | | | *Leptocheirus pinguis* | tube maker amphipod |
| | | | | *Casco bigelow* | |
| | | Mysidacea | | | |
| | | | | *Mysis mixta* | mysid |
| | | Decapoda | | | |
| | | Natantia | | | |
| | | | | *Eualus gaimardii* | small northern shrimp |
| | | | | *E. pusiolus* | small northern shrimp |
| | | | | *E. fabricii* | small northern shrimp |
| | | | | *Lebbeus polaris* | small northern shrimp |
| | | | Reptantia | | |
| | | | | *Pagurus arcuatus* | hairy hermit crab |
| | | | | *P. pubescens* | |
| | | | | *Hyas araneus* | toad crab |
| | | | | *H. coarctatus* | |
| Echinoidermata | | | | | |
| | | | | *Cucumaria frondosa* | sea cucumber |
| | | | | *Strongylocentrotus droebachiensis* | sea urchin |
| | Ophiuroidea | | | | |
| | | | | *Ophiopholis aculeata* | daisy brittle star |
| Chordata | | | | | |
| | Pisces | | | | |
| | | | | *Gasterosteus aculeata* | three spine stickel back |
| | | | | *Ulvaria subbbifurcata* | radiated shanny |
| | | | | *Pholis sp.* | gunnel |
| | | | | *Unidentified* | |